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Two Dimensions of Convergence: National and International Wage Adjustment Effects of Cross-Border Outsourcing in Europe

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Abstract

This paper proposes to distinguish the two dimensions of convergence - *within* and *between* countries - when analyzing the impact of cross-border outsourcing on real wage rates in the EU15 and the CEEC. In the CEEC, international outsourcing has not affected the adjustment of average real wage rates at the manufacturing industry level, but it has lead to a closure of the gap within a typical EU economy. Between country convergence is likewise fostered by cross-border outsourcing, supporting the hypothesis that outsourcing facilitates international factor price equalization.

Keywords: Convergence, Real Wages, Outsourcing, Panel Econometrics

JEL: F11, F15, J31

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1 Introduction

The driving forces of international factor price convergence and the international distribution of income has attracted a lot of interest in the last decades. Especially, the role of international trade in final goods, but also of trade in intermediate goods resulting from cross-border outsourcing of production processes, have been discussed as forces towards factor price equalization between the developed (the North) and the less developed economies (the South). Nowadays, researchers widely agree upon the notion that goods trade per se does not provide a sufficient explanation for the change in factor prices (Krugman, 1995; Feenstra & Hanson, 2001). However, the changing *composition* of trade and the growing importance of *intermediate input trade* in particular seems much more important regarding both theory and evidence (compare Feenstra & Hanson, 2001, for an overview).

Baier & Bergstrand (2001) derive simulation results from a stylized computable general equilibrium model. Using reasonable parameter estimates, they find that outsourcing might account for about one sixth of the growth of world trade in between 1960-1990. Hummels et al. (2002, p. 15) find that "vertical specialization accounts for up to 30 percent of world exports".

The theoretical literature predominantly focuses on the effects of international outsourcing on the national skilled-to-unskilled workers' wage differential and the international equalization of skill-specific factor rewards (Arndt, 1997; Deardorff, 2001; Feenstra & Hanson, 2001; Jones & Kierzkowski, 2001; Kohler, 2001; Kohler, 2002; etc.).[1] In a large cross-section of economies and

[1] Deardorff (2001, p. 135) concludes that, if there are some impediments to factor price equalization (e.g. transportation costs, tariff or non-tariff barriers to trade, etc.),

industries, the lacking availability of comparable industry level data on skill premia dictates an indirect approach. Nevertheless, in the now standard models of outsourcing, the equalization of *average* wages *within* and *between* countries is a possible (though not necessary), and empirically highly relevant outcome.

In the short run, the lack of labor mobility between sectors within a country due to national barriers to mobility (e.g. because of industry specific knowledge of workers) and adjustment costs may impede the effects of outsourcing on incomes to take place immediately. It is a stylized fact that wage differentials vary systematically across industries with capital intensive industries paying higher wages, and that these wage differentials are quite persistent over time (Krueger & Summers, 1988). However, in the steady state, one would expect that the wages of skilled and unskilled workers grow at the same rate and wage differentials between industries within a country as well as between countries do not change. In the long run, average wage rates (comprising both that of skilled and unskilled workers) may differ across industries because a different mix of skilled and unskilled workers is used, e.g. due to worker quality variation even within skill groups.

To give a clearer intuition concerning the impact of outsourcing on av-

outsourcing may drive factor price equalization to "the extent that factor prices are not equalized internationally without outsourcing". Jones & Kierzkowski (2001, pp. 31.) mention that depending on the extent of dissimilarity in factor endowment proportions outsourcing may "bring factor prices closer together", but generally "almost anything can happen". Kohler (2002) derives similar conclusions in his higher dimensional analysis of outsourcing effects, which contains the models of Arndt (1997) and Feenstra & Hanson (1996, 1997) as special cases.

erage wages, consider a stylized version of Arndt's (1997) small economy Heckscher-Ohlin type model. Specifically, assume there are two sectors: machines and textiles. Machines are produced with skilled labor only, while textile production involves the employment of both skilled and unskilled labour. Moreover, textiles may be fragmented into two stages. The first fragment uses both skilled and unskilled labour, but less so than machines. The second fragment, in contrast, only employs unskilled labour. Since both countries are small, the prices of the final goods as well as the fragments are determined by the world markets and treated exogenously. The consequences of outsourcing for the changes in the national (across sectors) and the international (across countries) differential in *average* wages can be illustrated, when comparing the autarky situation with the cum outsourcing equilibrium. Assume that both countries produce machines, but relatively skilled labour rich *Home* fully specializes in the skilled labour intensive fragment of textiles, whereas unskilled labour rich *Foreign* fully specializes in the second fragment of textiles production. For simplicity, assume that both factors and fragments are combined at constant proportions. In this setting, one can easily show that (i) the gap in *average* wages *within Home* declines. Wages of skilled labour are fixed by assumption, while wages of unskilled labour increase. The increase in the skill intensity in textiles production due to outsourcing reinforces this effect. (ii) Also *within Foreign*, wages of skilled labour are constant and rewards of unskilled labour rise. However, in the cum outsourcing equilibrium skilled labour is only used in machines production, whereas the textiles sector now employs unskilled labour, exclusively. Therefore, the wage gap across industries declines, if the change in the skill

intensity in the textiles sector is sufficiently small. Otherwise, we may observe divergence of average wages within Foreign. (iii) Factor endowments are fixed and the wages of unskilled labour rise in both economies, and Foreign is relatively better endowed with unskilled labour. Consequently, we observe convergence of average wages *between countries*. Of course, other results are also possible. However, our example demonstrates that convergence of *average* wages both *within* and *between* countries can principally be explained by a standard theoretical outsourcing model.

The available empirical evidence on the consequences of cross-border outsourcing at the industry level for both the US and Europe mainly supports the Heckscher-Ohlin view: Feenstra & Hanson (1999, 2001), Greenaway et al. (1999), Egger & Egger (2001) and others identify a clear positive impact of outsourcing on the skilled-to-unskilled wage and/or employment ratio in high wage countries. Feenstra & Hanson (1997) provide evidence that outsourcing raises the skilled-to-unskilled wage ratio in both the North (the US) and the South (Mexico). These shifts in relative labor demand and in relative wages mainly occur within industries rather than between industries. So far, evidence on the impact of outsourcing on the convergence of average wages in a large cross-section of industries and economies seems not available.

This paper tries to fill this gap and assesses the effects of international outsourcing on the convergence of average wages both *within* and *between* countries in a unified empirical framework. We propose an empirical model to assess the impact of outsourcing in these two dimensions using 2-digit manufacturing industry level data of the 15 EU members and 5 CEEC[2] covering

[2]Czech Republic, Hungary, Poland, Slovenia and Slovak Republic.

the period 1993-1999. Given that in the steady state wage differentials are constant, outsourcing may be expected to affect the speed of convergence, but not to induce differences in steady state growth rates. Therefore, we start from a traditional β-convergence model as proposed by Barro & Sala-i-Martin (1995), which is designed to analyze dynamic adjustment processes with one-way cross-sectional units - e.g., countries, regions, firms. However, to decompose the outsourcing effect into its *within* and *between* countries component, we account for the "two-way" character of the cross-sections and come up with a bivariate system of differential equations, which drives the country-by-industry evolution of real wage rates.

According to our main empirical results, *between* country convergence dominates the adjustment of real wage rates and outsourcing tends to reinforce this. *Within* country convergence, in contrast, is much slower. Outsourcing accelerates within country convergence in the EU15, while it does not lead to convergence in the CEEC, where interindustry wage differentials seem persistent in the typical economy. Our results support the notion that outsourcing facilitates *international* factor price equalization. Furthermore, in the stylized model discussed above, outsourcing does not induce divergence of average wages within either country. Also in this respect, our estimation results do not square with theory.

The paper proceeds as follows. The next section introduces the concept of the two dimensions of convergence, while Section 3 discusses the data base, the econometric specification, and the estimation results. The last section summarizes the main findings and concludes.

2 Two Dimensions of Convergence

To measure the speed of convergence of real wages *between countries* and across industries *within countries*, we propose an extension of the standard β-convergence equation. Specifically, we hypothesize that the speed of convergence differs between the within country (between industries) dimension (b_1) and the between country dimension (b_2). If $b_1 < b_2$, the overall catching up in real wage rates between countries dominates. If, on the other hand, $b_1 > b_2$ the interindustry wage rate differentials disappear quickly, but overall (between countries) catching up is slow.

For a typical industry i in country c, convergence requires that the growth rate of a country's real wage rate is negative proportional to its initial level (Barro & Sala-i-Martin, 1995). Formally, the log linearization around the steady-state is given by the following system of linear first order differential equations:

$$\frac{d\omega_{ic}(t)}{dt} - \frac{d\omega_{.c}(t)}{dt} = -b_1 \left[\omega_{ic}(t) - \omega_{.c}(t)\right] \quad (1)$$

$$\frac{d\omega_{.c}(t)}{dt} - \frac{d\omega^*(t)}{dt} = -b_2 \left[\omega_{.c}(t) - \omega^*(t)\right] \quad (2)$$

$$\frac{d\omega^*(t)}{dt} = g. \quad (3)$$

$\omega_{ic}(t) = \log w_{ic}(t)$ is the log of the real wage rate of industry i in country c, $\omega_{.c}(t) = \frac{1}{I}\sum_{i=1}^{I} \omega_{ic}(t)$, where I denotes the number of industries. $\omega^*(t)$ denotes the log of the 'world wide' steady-state of the real wage rate at time t with assumed constant growth rate g. (2) states that the difference between a country's real wage growth ($\frac{d\omega_{.c}(t)}{dt}$) and the steady-state growth rate $\frac{d\omega^*(t)}{dt}$ is higher, the higher the distance of the average log real wage rate of country

c ($\omega_{.c}(t)$) from its steady-state counterpart ($\omega^*(t)$) at time t. (1) implies that the real wage rate in industry i grows faster, the more it lags behind the average country wide real wage rate. For simplicity, we assume that a single industry is too small to influence the country average. Hence, the system is only an approximation of the true, by far more complicated, system, where the real wages of all industries show up on the right hand side of (1). Solving this system of differential equations, results in the following equation for a period of length T:

$$\omega_{ic}^T = e^{-b_1 T}\left(\omega_{ic}^0 - \omega_{.c}^0\right) + e^{-b_2 T}\left(\omega_{.c}^0 - \omega^{0,*}\right) + \omega^{T,*}. \tag{4}$$

(3) implies that the steady-state real wage rate in logs is defined by $\omega^*(t) = gt + \omega^{0,*}$ with $\omega^{0,*}$ as the exogenously given steady-state log wage rate at time 0. Subtracting the initial value ω_{ic}^0 from both sides of (4), rearranging terms, dividing by T, and adding an iid error term u_{it}, we get a natural extension of the traditional convergence equation (Barro & Sala-i-Martin, 1995) for the annual average growth rate of real wages in industry i over a period of length T:

$$\begin{aligned} \frac{1}{T}\left(\omega_{ic}^T - \omega_{ic}^0\right) &= g - \frac{1}{T}\left(1 - e^{-b_1 T}\right)\left(\omega_{ic}^0 - \omega_{.c}^0\right) - \\ &\quad \frac{1}{T}\left(1 - e^{-b_2 T}\right)\left(\omega_{.c}^0 - \omega^{0,*}\right) + u_{it}. \end{aligned} \tag{5}$$

β-convergence is a necessary, however not sufficient, condition for convergence (Barro & Sala-i-Martin, 1995). Therefore, we additionally look at σ-convergence and investigate, whether the standard deviation of real wage rates decreased over time, again both *within* and *between* countries. Formulating the system (1)-(3) in discrete time, substituting (2) and (3) in (1) and

adding a random iid error term, which is uncorrelated with the right hand side variables, gives:

$$\omega_{ic}^{t} = \beta_1 \left(\omega_{ic}^{t-1} - \omega_{.c}^{t-1}\right) + \beta_2 \left(\omega_{.c}^{t-1} - \omega^{t-1,*}\right) + \omega^{t,*} + u_{it}, \tag{6}$$

where $\beta_1 = 1 - b_1$ and $\beta_2 = 1 - b_2$. The standard deviation of ω_{ic}^{t} can be easily calculated, when assuming that the overall mean of the real wage rate approximately corresponds to the steady-state: $\frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}\omega_{ic}^{t} = \omega_{..}^{t} = \omega^{t,*}$, where C denotes the number of countries, and IC is the overall number of (country-by-industry) observations. Since $\omega_{..}^{t} = \frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}\omega_{ic}^{t} = \frac{1}{IC}\sum_{c=1}^{C}\beta_1\left(\omega_{.c}^{t-1} - \omega_{.c}^{t-1}\right) + \frac{1}{C}\sum_{c=1}^{C}\beta_2\left(\omega_{.c}^{t-1} - \omega^{t-1,*}\right) + \omega^{t,*} = \omega^{t,*}$, we have:

$$\begin{aligned}
\sigma_t^2 &= \frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}\left(\omega_{ic}^{t} - \omega_{..}^{t}\right)^2 + \sigma_u^2 \\
&= \frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}\left[\beta_1\left(\omega_{ic}^{t-1} - \omega_{.c}^{t-1}\right) + \beta_2\left(\omega_{.c}^{t-1} - \omega^{t-1,*}\right)\right]^2 + \sigma_u^2 \\
&= \frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}[\beta_1^2\left(\omega_{ic}^{t-1} - \omega_{.c}^{t-1}\right)^2 + 2\beta_1\beta_2\left(\omega_{ic}^{t-1} - \omega_{.c}^{t-1}\right)\cdot \\
&\quad \left(\omega_{.c}^{t-1} - \omega^{t-1,*}\right) + \beta_2^2\left(\omega_{.c}^{t-1} - \omega^{t-1,*}\right)]^2 + \sigma_u^2 \\
&= \beta_1^2\sigma_{t-1,W}^2 + \beta_2^2\sigma_{t-1,B} + \sigma_u^2,
\end{aligned} \tag{7}$$

where $\sigma_{t,W}^2 = \frac{1}{IC}\sum_{c=1}^{C}\sum_{i=1}^{I}\left(\omega_{ic}^{t} - \omega_{.c}^{t}\right)^2$ and $\sigma_{t,B}^2 = \frac{1}{C}\sum_{c=1}^{C}(\omega_{.c}^{t} - \omega^{t,*})^2$.

Hence, there are three principal opportunities to estimate the parameters of the two dimensions of convergence in real wage rates. First, we can use (5) to estimate the speed of convergence in a cross-section of industries and countries. Second, one can estimate (6) in a panel with industry, country and time variation using the procedure proposed by Arellano & Bond (1991). Third, one could look at σ-convergence based on a regression of (7). Since

the time series dimension of our data is rather short, the latter is not feasible. Rather, we look at a plot of σ_t^2, $\sigma_{t,W}^2$ and $\sigma_{t,B}^2$ against time and follow Carree & Klomp (1997) to test, whether the variance of real wage rates decreased over the period 1993 and 1999.

We assume that the speed of convergence depends on the volume of intermediate goods trade as percent of gross production (outsourcing: o_{ic}), whose impact may differ *within* and *between* countries and also between the CEEC and the EU15. Noteworthy, we rule out the possibility that the *level* of outsourcing exerts any impact on the steady-state *growth* of wage rates. Rather, we assume that it affects only the *level* and the corresponding *transition* path. Hence, the wage growth effects of outsourcing are assumed to be transitory. The rationale is the analogy to the impact of exogenous, labor augmenting technical progress on the *level* of labor productivity in a Solow-Swan type neoclassical growth model (see Barro & Sala-i-Martin, 1995).

3 Data and Estimation Results

Data: Our data comprise 14 manufacturing industries, which are slightly higher aggregated than NACE 2-digit ones. For simplicity, we refer to them as 2-digits. The real wage data for the EU countries are taken from New Cronos Products (EUROSTAT). The CEEC wages are kindly provided by the Vienna Institute for International Economic Studies (WIIW). Wages are expressed in constant prices and US dollars using 1995 as the base year. For the EU-countries, we have to estimate the 1999 values from production data using a fixed industry-by-country within estimator. All wages are de-

flated by country specific GDP-deflators and expressed in 1995 dollars, and we calculate average growth rates in line with the bulk of the convergence literature.

To construct the outsourcing variable, we use data on bilateral intermediate goods trade volumes at the 5-digit Standard International Trade Classification level from UNO's Broad Economic Categories (compare Fontagné et al., 1996) and aggregate them to come up with NACE 2-digit manufacturing industry input trade volumes of each country with the EU and the CEEC. We aggregate each country's bilateral trade in intermediate goods with the EU and CEEC as the destination countries. For example, the outsourcing measure of a specific German NACE 2-digit manufacturing industry is the sum of Germany's exports and imports of intermediate goods of this industry to all other EU-countries and the CEEC, and similarly for all other economies in the sample. In this way, we capture the impact of the overall volume of intermediate goods trade on the convergence of real wage rates and treat all countries symmetrically. We express European 2-digit industry input trade volumes in percent of a country's gross production to obtain a (wide) measure of the country specific European (intra-sample) level of cross-border outsourcing of production. A couple of missing values are interpolated, especially for Greece. In the regressions below, the initial value refers to 1993.

Our data are heavily prone by outliers, so we have to restrict the sample in several ways. We exclude all country-by-industry cross-sections (i) with a maximum average annual *growth rate* of real wages exceeding 50% in absolute value, (ii) with a maximum *level* of the outsourcing measure above the 95-

percentile in a single year, and (iii) industries with an annual increase in our outsourcing measure of more than 300%. The latter two criteria likely capture misclassifications or data errors in the trade or industry statistics.

Table 1 presents the summary statistics of average annual growth rates of both European outsourcing in percent of gross production and that of the real wage rate in the EU15 area and 5 CEEC.[3]

> Table 1 <

Starting from significantly lower wage rates after the Fall of the Iron Curtain and the first step of systemic transformation, real wages grew substantially faster in the CEEC than in the EU. Outsourcing in terms of gross production by the EU countries increased faster during 1993 and 1999 as compared to the CEEC. Noteworthy, this pattern is largely due to the increase in imports of manufacturing inputs originating from the EU countries themselves.

Econometric Specification: We estimate (5), allowing outsourcing to affect the adjustment process (i.e., the speed of adjustment) to the steady-state real per capita wage rate both within and between countries. The

[3]We exclude Bulgaria and Romania from the available sample becuase of the missing trade data. Additionally, the wages in these two economies seem to follow a rather different growth pattern than in the included CEEC.

associated β-convergence regression reads as follows:

$$\begin{aligned}\Delta\omega_{ic} &= \gamma_0 + \gamma_1\widetilde{\omega}^0_{ic} + \gamma_2\widetilde{\omega}^0_{ic}o^0_{ic}D_{EU} + \gamma_3\widetilde{\omega}^0_{ic}o^0_{ic}D_{CEEC} \\ &\quad \gamma_4\omega^0_{.c} + \gamma_5\omega^0_{.c}o^0_{ic}D_{EU} + \gamma_6\omega^0_{.c}o^0_{ic}D_{CEEC} + u_{ic} \qquad (8)\end{aligned}$$

$$\begin{aligned}\Delta\omega_{ic} &= \frac{\ln w^t_{ic} - \ln w^0_{ic}}{T} \\ \widetilde{\omega}^0_{ic} &= \left(\omega^0_{ic} - \omega^0_{.c}\right) \\ o^0_{ic} &= \frac{(\text{Intermediates goods trade volume})^0_{ic}}{(\text{gross production})^0_{ic}}.\end{aligned}$$

D_{EU} takes the value 1, if a country belongs to the EU and 0 otherwise, and $D_{CEEC} = 1 - D_{EU}$ is the CEEC dummy. According to the discussion above, we allow European cross-border outsourcing to exert a different impact on the convergence *within* countries (i.e., between industries within a country: γ_2, γ_3) than on *between* country convergence (γ_5, γ_6). Furthermore, we allow outsourcing to affect the EU economies (γ_2, γ_5) and the CEEC (γ_3, γ_6) differently. γ_0 is the common steady-stage growth of real wages. In this form, the specification implies *unconditional convergence*. Similar to previous work, we account for the other determinants of convergence by the direct effects of the initial levels (γ_1, γ_4). In a second specification, we add industry dummies to control for other unobserved industry specific determinants of the steady-state growth of average wages (compare Carree et al., 2000, for a similar approach). The resulting long run differences in real wage growth rates may arise from shifts in the skill composition and, inter alia, also from short run asymmetric business cycle effects. This specification implies *conditional convergence*.

Figure 1: Density Estimates of the Log Real Wage Rate 1993 and 1995

As discussed in Quah (1993), β-convergence is not sufficient to guarantee overall convergence to a common steady-state. Therefore, additional evidence on the distribution of real wages must be considered to assess the information obtained from the above regressions. Convergence to a single-peaked distribution supports results from β-convergence regressions.

Figure 1 illustrates that the distribution of real wage rates exhibits a two-peaked pattern in our initial period (1993) with the CEEC lagging considerably behind. But in course of the transitional process of the CEEC, the left peak of the distribution moved towards the right one. From this perspective, convergence of the real wage distribution to a single peak, i.e., a common steady-state, seems not unlikely and β-convergence analysis is informative.

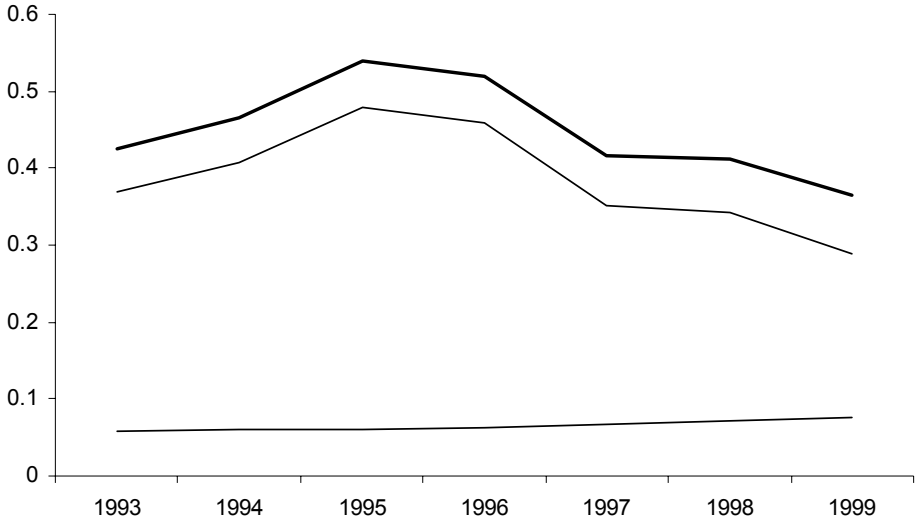

Figure 2: σ-Convergence of EU15 and CEEC Real Wage Rates and Its Components

Assuming single-peakedness, we further look at the distribution of wages and compute the associated variance (σ^2) of real wages both across countries and industries to see wether the distribution of real wages significantly collapses over time. As mentioned above, the small time dimension of our data does not allow to apply regression analysis. However, Figure 2 illustrates that the dispersion of real wages is falling since 1995. This process is driven by convergence of average wages *between* economies rather than *within* them. According to the t_2-statistic by Carree & Klomp (1997), differences in real wage rates *between* countries were significantly larger in 1993 than in 1999 ($t_2 = 40.2$, $p = 0.00$). Also, the *overall* decrease in the variance is significant ($t_2 = 12.8$, $p = 0.00$). However, *within* the typical economy we observe a slightly increasing dispersion between

industries.

Estimation Results: Comparing the results between the conditional and the unconditional convergence regression in the table, we find that the hypothesis of a common steady-state across industries is rejected. This points to long run differences in real wage growth rates across industries common to all countries and/or short run asymmetric business cycle effects not explicitly addressed in the theoretical models discussed above. Nevertheless, the resulting point estimates of the convergence parameters are relatively similar, with some important exceptions.

The evidence suggests that outsourcing in the CEEC has impeded the pace of adjustment to the industry steady-state *within countries*. However, this result is only significant in the unconditional convergence specification. In contrast, outsourcing has lead to a significant closure of the gap between observed and steady-state wage rates within the typical EU economy in the conditional convergence regression.

All estimated between country convergence parameters are significantly different from zero, and we find that outsourcing fosters convergence of the CEEC (i.e., convergence *from below*) stronger than it speeds up convergence in the EU area (on average, convergence *from above*). This finding is significant in both the conditional and the unconditional convergence regressions (compare the corresponding F-test of $(c) - (d) = 0$ in Table 2). In both estimated models, the marginal *between* country convergence effects of outsourcing are significantly more pronounced than their *within* country counterparts (compare the last row of F-tests in the table).

> Table 2 <

We have assessed the robustness of the estimation results in several ways.[4] First, we applied median regressions to check for the influence of potential remaining outliers. In fact, the results are very close to the OLS outcome and our results are not driven by a view influential observations. Second, we ran dynamic panel GMM regressions in the spirit of Arellano & Bond (1991) and found - though the time period is rather short for single–equation GMM - that the coefficients of the interaction terms by and large are rather robust in terms of both their sign and significance. However, to obtain reliable GMM estimates in terms of Sargan's over-identification test, we had to control for country-specific time effects, which wipe out the direct impact of the lagged between country effect, rendering any further discussion of long-run between country differences impossible. Given these results, we can proceed with the analysis on the basis of the estimates in Table 2.

> Table 3 <

Table 3 collects information on the speed of adjustment, expressed as the average annual closure of the gap between actual and steady-state real wage rates for the EU and the CEEC. To illustrate the role of outsourcing, we report the estimated speed of adjustment for outsourcing as observed and a counterfactual situation with zero outsourcing in the initial period. Since unconditional convergence is rejected at convenient levels of significance, we

[4] We do not report all of our results for the sake of brevity. However, they are available from the authors upon request.

concentrate on the conditional convergence results (i.e., the lower bloc of results in the table). Outsourcing significantly speeds up the convergence of real wage rates *within countries* (between industries) in the EU15 economies to 6.86% per year when evaluated at variable means, whereas there is no such effect within the CEEC. Hence, in the EU15 outsourcing puts a significant pressure on industries with above average real wage rates in the typical economy, while it leads to faster adjustment in industries below the country average. Further, outsourcing significantly accelerates the speed of convergence *between countries* in both the EU (the difference between 3.56% and 3.08% is significant at 1%) and the CEEC (the difference between 4.37% and 3.08% is significant at 1%). Finally, the impact on the speed of adjustment in the CEEC is somewhat stronger (though only at $\alpha = 14\%$).

Summing up, our results support Deardorff's (2001) notion that outsourcing facilitates factor price equalization across countries. They are also in line with the models predicting convergence of average wages within countries (between industries) in the North due to higher wages of unskilled workers combined with minor increases in the demand for skilled workers as a result of outsourcing of unskilled labor intensive production stages.

4 Conclusions

This paper proposes a new concept to distinguish the two dimensions of convergence - *between* and *within* countries. We analyze the impact of outsourcing on the adjustment of real wage rates in manufacturing of the EU15 and 5 CEEC at the NACE 2-digit industry level. Specifically, we treat the

impact of outsourcing transitorily and look at its effect on the speed of adjustment, thereby allowing for an effect on the steady-state *level* of real wage rates but not on their *growth*.

The availability of data dictates to investigate the evolution of average real wages, which is nevertheless informative for the debate on the impact of outsourcing on the distribution of income within and between counties. We find pronounced *conditional convergence* in both the EU15 and the CEEC. Our estimation results furthermore suggest that outsourcing in the CEEC has not fostered the pace of adjustment *within* these economies. In contrast, outsourcing has lead to a closure of the gap between observed and steady-state wage rates *within* the EU countries. This is in line with the models of Arndt (1997) and others, which predict that in response to outsourcing of unskilled labor intensive production stages average wage rates may converge *within* the developed countries, while the gap in average wages may or may not converge *within* the developing ones, depending on the skill intensity of the remaining fragment.

Looking at the convergence *between* countries, cross-border outsourcing strongly fosters convergence *from below* for the CEEC and *from above* for most of the EU countries. Hence, our empirical estimates inter alia support the hypothesis derived from traditional models, namely that cross-border outsourcing increases the possibility of international factor price equalization (Deardorff, 2001).

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Table 1: Descriptive Statistics (Average Annual Growth in Percent)

Region	Real Wage Rate	Intermediate Inputs Trade in % of Production
EU15	2.05	4.67
CEEC	4.91	3.66
Average	2.87	4.38

Table 2: Regression Results (β-Convergence)
Dependent Variable is the Average Log Difference of Real Wages

Explanatory variables	Unconditional convergence		Conditional convergence	
	β	t-statistic	β	t-statistic
Within countries				
Initial level	0.007	0.41	-0.020	-0.72
Initial level x initial outsourcing x CEEC dummy (a)	0.104	2.31 **	0.057	1.02
Initial level x initial outsourcing x EU15 dummy (b)	-0.005	-0.73	-0.017	-1.96 *
Between countries				
Initial level	-0.031	-7.21 ***	-0.029	-7.05 ***
Initial level x initial outsourcing x CEEC dummy (c)	-0.014	-2.82 ***	-0.025	-3.96 ***
Initial level x initial outsourcing x EU15 dummy (d)	-0.001	-1.26	-0.002	-3.27 ***
Constant	0.114	10.91 ***	0.092	7.09 ***
Number of observations	240		240	
R^2	0.24		0.35	
Root mean square error	0.04		0.03	
Heteroskedasticity, Cook and Weisberg (1983): $\chi^2(1)$	5.11 **		7.44 ***	
F-tests:				
Industry effects: F(13,220)	-		3.26 ***	
Marginal outsourcing effects:				
(a) - (b) = 0; F(1,233)	5.00 **		0.82	
(a) - (c) = 0; F(1,233)	7.93 ***		15.71 ***	
(c) - (d) = 0; F(1,233)	7.25 ***		13.28 ***	
(b) - (d) = 0; F(1,233)	1.58		10.73 **	
(a) - (b) + (c) - (d) = 0; F(1,233)	8.11		17.26 ***	
(a) + (b) - (c) - (d) = 0; F(1,233)	7.25 ***		13.28 ***	

*** significant at 1%; ** significant at 5%; * significant at 1%. Reported t-statistics are heteroskedasticity corrected.

Table 3: Estimated Speed of Convergence - Annual Closure of the Gap in Percent

	Within countries		Between countries	
	Overall	Without outsourcing	Overall	Without outsourcing
	Unconditional convergence			
EU15	0.33	-0.66	3.49 ***	3.32 ***
CEEC	-4.52 ***	-0.66	4.07 ***	3.32 ***
	Conditional convergence			
EU15	6.86 **	2.10	3.56 ***	3.08 ***
CEEC	-0.43	2.10	4.37 ***	3.08 ***

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